Neonicotinoid Insecticides:
Efficacy, Non-target Effects, Best Practices

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Recent Relevant Journal Publications:

1) Krupke, C., Holland, J., Long, E., and B. Eitzer (2017). **Planting of neonicotinoid-treated maize poses risks for non-target organisms over a wide area without consistent crop yield benefit.** Journal of Applied Ecology DOI 10.1111/1365-2664.12924

http://onlinelibrary.wiley.com/doi/10.1111/1365-2664.12924/full

Summary: Three year field study examining the distance and concentrations of neonicotinoid residue movement in relation to honey bee forager movement during corn planting. Found that over 90% of honey bees in the study area (Indiana) are at risk of encountering residues during foraging. A simultaneous assessment of agronomic benefits for corn production found no yield benefits of neonicotinoid seed treatments at multiple locations during the study period, suggesting that rapid reductions in exposure of non-target organisms to neonicotinoids could be rapidly achieved by aligning use rates with pest incidence.

2) Alford A, Krupke CH (2017) **Translocation of the neonicotinoid seed treatment clothianidin in maize**. PLoS ONE 12(3): e0173836. https://doi.org/10.1371/journal.pone.0173836

Summary: Two-year field study compared concentrations of clothianidin seed treatments (ST) in maize to that of maize without NSTs and found NST present in root tissues up to 34 days post planting (DPP) to determine residence time in plant foliage. Plant-bound clothianidin concentrations followed an exponential decay pattern with initially high values followed by a rapid decrease within the first ~20 DPP. A maximum of 1.34% of the initial ST was successfully recovered from plant tissues in both study years and a maximum of 0.26% was recovered from root tissue.

3) Miles JC, Hua J, Sepulveda MS, Krupke CH, Hoverman JT (2017) **Effects of clothianidin on aquatic communities: Evaluating the impacts of lethal and sublethal exposure to neonicotinoids**. PLoS ONE 12(3): e0174171. https://doi.org/10.1371/journal.pone.0174171

Summary: Two-year field and lab study documenting compounds/levels of neonicotinoids in water and soil in a range of environments, incl. outside crop fields. Overall, 56% of soil and >90% of water samples contained multiple neonicotinoids. Concentrations of insecticide in water ranged from 0.67 ppb (clothianidin) to 2,568 ppb

for thiamethoxam. Imidacloprid and acetamiprid residues were also found in field samples.
Lab studies exposing aquatic invertebrates to range of clothianidin exposures, including levels at field sites generated new LC50 values ranging from 0.002 ppm to 1.2 ppm for aquatic invertebrates exposed to clothianidin.

4) Long, EY and CH Krupke. 2016. **Non-cultivated plants present a season-long route of pesticide exposure for honey bees.** *Nature Communications* 7, Article number: 11629 (2016)
https://www.nature.com/articles/ncomms11629

Summary: quantified principle pollen resources utilized by honey bees in maize and soybean dominated landscapes. Most are non-cultivated plants. Throughout the growing season, pollen collected by foragers in these landscapes is contaminated with high levels of both pyrethroids (mostly homeowner/nuisance pest formulations) and the neonicotinoids used as seed treatments. Many other agricultural pesticides prevalent, even when pollen from crop plants represents only a fraction of the total diversity.

Krupke, CH, Alford AM, Cullen EM, Hodgson EW, Knodel JJ, McCornack B, Potter BD, Spigler MI, Tilmon K and K Welch. 2017. **Assessing the value and pest management window provided by neonicotinoid seed treatments for management of soybean aphid (*Aphis glycines* Matsumura) in the Upper Midwestern United States**
Pest Management Science. http://onlinelibrary.wiley.com/doi/10.1002/ps.4602/abstract

Summary: Field study covering two field seasons and seven states that examined benefits of neonicotinoid seed treatments vs. an IPM (scout and treat at 250-aphid threshold) approach for soybean aphid management. Both treatments reduced total aphid pressure, but only the IPM treatment resulted in significant yield increases. Analysis of soybean foliage from thiamethoxam-treated seeds indicated that tissue concentrations of thiamethoxam were statistically similar to plants grown from untreated seeds beginning at the V2 growth stage, indicating that the period of pest suppression for soybean aphid is likely to be relatively short (ca. 2-3 weeks after planting).

Other relevant resources (available through Purdue University extension):

The effectiveness of neonicotinoid seed treatments in soybean
https://extension.entm.purdue.edu/publications/E-268/E-268-W.pdf
Protecting honey bees from pesticides, revised 2016:
https://extension.entm.purdue.edu/publications//E-53/E-53.html

New in 2016:
Pollinators and commercial pesticide application:
https://extension.entm.purdue.edu/publications/POL-3/POL-3.html
Pollinators and agronomic crops:
http://edustore.purdue.edu/item.asp?Item_Number=POL-4#.WIFSR4WkL6Y
Pollinators and fruit/vegetable crops

https://extension.entm.purdue.edu/publications/POL-2/POL-2.html
Pollinators and home/garden plantings
https://extension.entm.purdue.edu/publications/POL-1/POL-1.html